Oral health in frail elderly

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Chapter 5

Influence of age on clinical performance of mandibular 2-implant overdentures. A 10-years' prospective comparative study

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Abstract

Objective: The aim of this prospective comparative study was to assess whether age has influence on peri-implant health in patients treated with mandibular 2-implant overdentures during a 10 years' evaluation period.

Materials and methods: A prospective study was carried out with two groups of edentulous patients, viz., a younger (n=52; mean age 45 years, 35-50 years) and an older (n=53; mean age 68 years, 60-80 years) group. In all patients, two dental implants were placed in the interforaminal region of the mandible and after a three-months' healing period overdentures were fabricated. Clinical and radiographic parameters were evaluated immediately after completion of the prosthetic treatment, and after 1, 5 and 10 years. Implant loss, plaque-index, gingival-index, bleeding-index and probing depth were assessed as clinical parameters. Peri-implant bone loss was assessed on dental radiographs made with a standardized long-cone technique with a direction device.

Results: Implant survival after 10 years was 97.1% and 93.4% in the younger and older group, respectively. Ten-years scores of plaque, gingiva, and bleeding were between 0 and 1 for both groups (possible scores 0-3), and mean probing depth was 3 mm in both groups. Mean peri-implant bone loss after 10 years was 1.2 mm and 1.4 mm in the younger and older patients, respectively. No significant differences were observed between the groups.

Conclusion: Clinical performance of mandibular 2-implant overdentures is equally successful in younger and older patients.

Introduction

Edentulous patients often experience problems with their mandibular dentures. Lack of stability and retention, together with a decreased chewing ability are the main complaints of these patients.[1] The currently preferred treatment for these patients is to place 2 endosseous implants in the interforaminal area in order to find retention for an overdenture. One of the first studies concerning overdentures supported by endosseous implants was by van Steenberghe.[2] Survival of implants used to retain mandibular overdentures and patients' satisfaction with these overdentures revealed very high scores.[3,4] A variety of clinical trials has revealed that patients with a mandibular implant-supported overdenture are significantly more satisfied than patients with a conventional complete denture, not only after one year,[5] but also after 10 years.[6]

As humans live longer, the number of edentulous elderly will increase (Douglass 2002).[7] It is likely that patients will seek improvement asking for placement of endosseous implants to retain their mandibular overdenture. However, rise of implant therapy in the coming decades will take place in only some parts of the world, because it will be strongly dependent on the economical situation.[8,9] It has been assumed that survival rates for implants in older and younger adults are comparable, but bone and soft tissue healing after implant placement might become compromised with aging.[10,11] Additionally, differences in bone to withstand chewing forces might become worse with age as well as that elderly may experience difficulties to continue the high standard of oral care needed to clean the small intraoral superstructure components.[12]

A number of studies has been carried out to compare implant outcomes in older and younger adults.[13-19] All studies revealed that there are no differences in implant success between youngsters and elderly. However, the follow-up periods of most studies was short, the follow-up did not exceed two or three years. Only Bryant and Zarb[17] reported results of a follow-up period of up to 14 years. They reported that cumulative implant success in younger and older patient groups both exceeded 86.7%. However, their study involved a variety of prosthesis designs. The implants were used as retention for single crowns, short span prostheses, complete arch prostheses and removable overdentures. Therefore, the aim of this prospective comparative study was to assess the influence of age on peri-implant health in patients treated with mandibular 2-implant overdentures during a 10 years' evaluation period.

Material and methods

Patients for this evaluation originate from two clinical trials in which edentulous patients were supplied with a mandibular overdenture on two endosseous implants. Short-, medium- and long-term results of these studies were published before.[19-25] All patients had persistent problems with their conventional complete dentures due to reduced stability and insufficient retention of their mandibular denture. All patients had a conventional removable maxillary denture. The following groups were combined for the evaluation, making the study design a subanalysis of two independent prospective studies:

From the study of Batenburg.[20]

- patients treated with the two-stage 4 mm diameter IMZ cylinder implant with TPS coating (Dentsply Friadent, Mannheim, Germany) (**Fig. 1A**);
- patients treated with the two-stage 3.75 mm diameter Brånemark screw implant with a machined surface (Nobel Biocare Holding AG, Zürich, Switzerland) (**Fig. 1B**);
- patients treated with the one-stage 4.1 mm diameter ITI solid screw implant with TPS coating (Institut Straumann AG, Basel, Switzerland) (**Fig. 1C**).

Fig. 1: Intraoral view on the original bar attachment system.

Fig. 1A IMZ cylinder implant system.

Fig. 1B Brånemark screw implant system.

Fig. 1C ITI solid screw implant system.

From the studies of Heijdenrijk (2002a,b). [21,22]

- patients treated with the two-stage 4 mm diameter IMZ cylinder implant with TPS coating;
- patients treated with the two-stage 4 mm diameter IMZ cylinder implant with TPS coating, but surgery was carried out in a one-stage procedure;
- patients treated with the one-stage 4.1 mm diameter ITI solid screw implant with TPS coating;

Three months after implant-placement, all patients were provided with a new maxillary complete denture and a mandibular overdenture supported by a bar and clip attachment. Originally, in the study of Batenburg, a round-shaped bar with Ackermann clip was used. In the study of Heijdenrijk, an egg-shaped Dolder bar with corresponding clip was used. Because of multiple loosening and fracture of the Ackermann clips, in time all round bars were replaced by egg-shaped Dolder bars. A conventional loading protocol was used. The procedures are described in detail by Batenburg[20] and Heijdenrijk.[21,22]

Two weeks after the abutment connection (for the two-stage implant systems) or two weeks after implant placement (for the one-stage implant system) an oral hygiene instruction was given. Two weeks thereafter this was checked and, if necessary, an additional instruction was given. At each yearly evaluation visit, the study patients were also recalled by the oral hygienist for removal of plaque and calculus and additional instruction. Patients were instructed to use a soft tooth brush and dental superfloss. If necessary, patients were recalled every six months.

Two groups of patients were selected on the basis of age for the present study:

1) a younger group (n=52) with an age of 50 years or less (mean age 45 years, range 34-50 years);
2) an older group (n=53) with an age of 60 years or more (mean age 68 years, range 60-80 years).

After the study of Bryant and Zarb[18], patients with an age between 50 and 60 years were not included to ensure a clear distinction between the groups. Characteristics of the groups are listed in **Table 1**. Bone height was measured on a rotational panoramic radiograph with correction for distortion. Bone quality was determined according to Lekholm and Zarb[26] with the use of a lateral cephalometric radiograph.
For the purpose of the current study, data collected at four time points after implant placement were used, viz., T_0 (baseline evaluation after placement of the overdenture), T_1 (evaluation 1 year after placement of the overdenture), T_5 (evaluation 5 years after placement of the overdenture) and at T_{10} (evaluation 10 years after placement of the overdenture).

Table 1. Characteristics of the younger group and the older group at the baseline of the study.

	Younger group (n=52)	Older group (n=53)
Mean age in years (min-max)	45 (34-50)	68 (60-80)
Gender; number male/female	11/41	22/31
Mean edentulous period lower jaw in years (sd)	19 (8)	25 (14)
Mean mandibular bone height in mm (sd)	17.2 (2.2)	16.4 (2.9)
Mean bone quality (possible score 1-4)	2.6	2.5

Clinical analysis

The clinical analysis included a number of parameters. Loss of implants was scored after removal of a loose implant any time after placement. For presence of plaque, the index according to Mombelli was used[27] (score 0: no detection of plaque, score 1: plaque can be detected by running a probe accross the smooth marginal surface of the implant, score 2: plaque can be seen by the naked eye, score 3: abundance amount of plaque). The presence of calculus (score 1) or the absence of calculus (score 0) was scored. To qualify the degree of peri-implant inflammation, the modified Löe and Sillnes index was used[28] (score 0: normal peri-implant mucosa, score 1: mild inflammation; slight change in colour, slight edema, score 2: moderate inflammation; redness, edema and glazing, score 3: severe inflammation; marked redness and edema, ulceration). For bleeding, the bleeding index according to Mombelli was used[27] (score 0: no bleeding when using a periodontal probe, score 1: isolated bleeding spots visible, score 2: a confluent red line of blood along the mucosal margin, score 3: heavy or profuse bleeding). Probing depth was measured at 4 sites of each implant (mesially, labially, distally, lingually) by using a periodontal probe (Merit B, Hu Friedy, Chicago, USA) after removal of the bar; the distance between the marginal border of the mucosa and the tip of the periodontal probe was scored as the probing depth.

Radiographic analysis

Standardized intraoral radiographs of each implant were obtained using a beam direction device as described by Meijer[29] Analysis was done with a digital sliding gauge (Helios digit E 2056, Schneider & Kern, Niedernhall, Germany) with which two-point measurements were made along the implant axis from a fixed reference point to the level of bone.[30] Measurement was performed mesially and distally of each implant.

Data analysis

In analyzing the clinical and radiographic data, the worst score of each item per patient was used as representative for the status at that evaluation period. Analysis was done with PASW Statistics 22.0 (SPSS Inc.: An IBM Company, IBM Corporation, Chicago, IL, USA). In all tests a significance level of 0.05 was chosen.

Results

All patients were present at T_0 (evaluation after placement of the overdenture). At T_1 (evaluation 1 year after placement of the overdenture) 1 patient of the older group did not attend the evaluation because of sickness. At T_5 (evaluation 5 years after placement of the overdenture) 5 patients of the older group did not attend the evaluation because of sickness and 2 patients had died. At T_{10} (evaluation 10 years after placement of the overdenture) 4 patients of the older group moved without leaving an address, 7 patients did not attend the evaluation because of sickness and another 5 patients had died.

One patient in the younger group lost both implants between 5 and 10 years. Another patient in the younger group lost one implant between 5 and 10 years. This resulted in an implant survival rate of 97.1% in the younger group at 10 years. One patient in the older group lost 1 implant during the osseointegration period. One implant was lost between overdenture placement and 1 year. Another 5 implants (2 implants in one patient) were lost between 5 and 10 years in the older group. This resulted in an implant survival rate of 93.4% in the older group at 10 years. Mobile implants were removed and after a bone healing period of six months, a second implant placement procedure was carried out. These second implants were not included in this evaluation study.

The scores on the indices for plaque, calculus, gingiva and bleeding were very low at all evaluation periods (**Table 2**). The only significant difference between the groups was at T_{10} for the plaque-index. This score was significantly worse in the older group. The mean probing depth did not exceed 3.5 mm and the difference between the groups was not significant (**Table 2**).

The mean change in marginal bone level is listed in **Table 3**. Between T_0 and T_{10} 1.2 mm bone was lost in the younger group and 1.4 mm in the older group. This difference, however, was not significant.

There were no significant differences between the time periods for neither of the groups. There were no significant differences between the different implant systems used in the study, nor any significant differences between men and women.

Table 2. Plaque-index (0-3), calculus-index (0-1), gingival-index (0-2), bleeding-index (0-3) and probing depth in mm at T_0 (evaluation after placement of the overdenture), T_1 (evaluation 1 year after placement of the overdenture), T_5 (evaluation 5 years after placement of the overdenture) and at T_{10} (evaluation 10 years after placement of the overdenture) and the significance level of the differences between the younger and older group.

		T_0: evaluation after placement of overdenture		T_1: evaluation after 1 year		T_5: evaluation after 5 years		T_{10}: evaluation after 10 years	
		Younger group (n=52)	Older group (n=53)	Younger group (n=52)	Older group (n=52)	Younger group (n=52)	Older group (n=46)	Younger group (n=51)	Older group (n=34)
Plaque-index	Median (IQR)	0 [0;1]	0 [0;1]	0 [0;1]	0 [0;1]	0 [0;1]	0 [0;2]	0 [0;1]*	0 [0;2]*
Calculus-index	Median (IQR)	0 [0;1]	0 [0;1]	0 [0;1]	0 [0;1]	0 [0;1]	0 [0;1]	0 [0;1]	0 [0;1]
Gingival-index	Median (IQR)	0 [0;1]	0 [0;0]	0 [0;1]	0 [0;0]	0 [0;1]	0 [0;1]	0 [0;0]	0 [0;0]
Bleeding-index	Median (IQR)	1 [0;1]	1 [0;1]	1 [0;1]	0 [0;1]	1 [0;1]	1 [0;1]	0 [0;1]	0 [0;0]
Probing depth	Mean (sd)	3.2 (0.9)	3.2 (1.3)	3.2 (1.0)	3.1 (1.0)	3.3 (1.0)	3.0 (0.9)	3.5 (1.2)	3.2 (1.1)

* for none of the clinical items there was a significant difference between the groups at T_0, T_1, T_5 and T_{10}, except for plaque-index at T_{10} (p=0.048)
IQR = interquartile range
sd = standard deviation

Discussion

The survival rate of implants in this prospective study was 97.1% in the younger group and 93.4% in the older group after 10 years in function. These percentages are comparable to other prospective studies which have reported survival rates of implants supporting a mandibular overdenture. Deporter[31] reported a ten-years survival rate of 92.7% for the Endopore dental implant system. Meijer[32] reported on a clinical trial with a 93% ten-years survival rate for IMZ implants and a 86% ten-years survival rate for Brånemark implants. Naert[33] reported a ten-years survival rate of 100% for Brånemark implants. Telleman[34] reported a ten-years survival rate of 96.6% for Hollow Screw ITI implants and 96.1% for Hollow Cylinder ITI implants in a retrospective study. Comparison with studies that distinguish between younger and older patients is difficult because a variety of prosthetic designs were used. Comparison can best be done with the study of Bryant and Zarb[18] because they presented a completely edentulous group with younger and older patients. Prosthesis design was a fixed complete denture or an overdenture. Age differentiation in the study of Bryant and Zarb[18] was the same as in the present group. The cumulative survival rate (up to 14 years) of the implants was 92.6% for the older group and 85.6% for the younger group with no statistical significance. Although implant survival rates were lower than in the present group, also in this study there was not a significant difference between the groups. Bone loss did not exceed 1 mm in both groups. However, only 11 mandibular overdentures were present in the younger group and 7 mandibular overdentures in the older group.

The scores on the indices for plaque, calculus, gingiva and bleeding were very low at all three evaluation periods for both groups. The strict oral hygiene regime to which patients were subjected apparently resulted in healthy periimplant tissues. The overall slightly poorer performance of the older group

Table 3. Mean change in marginal bone level (and standard deviation) during the first year (T_0-T_1), during the first 5 years after insertion of the overdenture (T_0-T_5), during 10 years after the insertion of the overdenture (T_0-T_{10}) and the significance level of the differences between younger and older group.

	Younger group	Older group	Significance
Mean change in marginal bone level between T_0 and T_1 in mm (sd)	- 0.5 (0.8) (n = 104)	- 0.4 (0.7) (n = 102)	not sign.
Mean change in marginal bone level between T_0 and T_5 in mm (sd)	- 1.2 (1.2) (n = 102)	- 0.8 (1.0) (n = 91)	not sign.
Mean change in marginal bone level between T_0 and T_{10} in mm (sd)	- 1.2 (1.1) (n = 99)	- 1.2 (1.2) (n = 64)	not sign.

(plaque-index) may reflect difficulty in manipulation of materials/devices needed to clean abutments and bar. However, plaque scores are still small and did not seem to influence the gingiva-index and the bleeding-index as indices for inflammation. The mean probing depth was not different between the groups and appeared to be stable over time.

Mean marginal bone loss in the present study did not exceed 1.5 mm for both groups at 10 years. In the present study standardized intra-oral radiographs were used, so comparison is done with other ten-years studies which have made intra-oral radiographs to evaluate peri-implant bone levels. Intra-oral radiographs were used in the study of Naert, who reported 1.2 mm bone loss for bar-connected Brånemark implants during the entire ten years follow-up.[33] Telleman reported 2.2 mm bone loss for bar-connected ITI-implants after ten years.[34] Up to 1 mm bone loss during the first year has been described previously and is related to maturation of bone after implant placement and adaptation of bone to withstand functional forces.[35] Small annual bone loss after this period has been recognized as acceptable and is also the case in the present study.[33] There was no statistical difference in bone loss between the two groups.

Patients for this evaluation originate from two clinical trials in which edentulous patients were supplied with a mandibular overdenture on two endosseous implants. Three different implant systems were present in the study, but no significant differences between the systems were calculated. The implant surfaces of the implant systems used in the study are rarely used anymore. The IMZ cylinder implant and the ITI solid screw implant had a TPS coating and the Brånemark screw implant had a machined surface. Apparently, these historical surfaces were performing well in the bone of the edentulous mandible. Reasons for this similar outcome might be that only well-documented, well-investigated and successful implant systems were used and that all three implant systems were restored following the same prosthetic protocol.

Notable is the large number of patient lost to follow-up in the older group compared to the younger group. Not only 7 patients had died after 10 years, but also 4 patients had moved (or it was presumed that they had moved because they were not responding to mail or telephone calls) and 7 patients were too sick to come to their recall visit. The latter patients were offered multiple appointment possibilities, but family or caretakers indicated that the physical or mental state of the patient made it impossible. Although nothing can be said about the oral health of people not evaluated, one must keep in mind that if patients are not able anymore to perform sufficient oral hygiene, peri-implant tissues are prone to infection and bone loss.[12] It seems that as long people are able to attend the yearly visits, age is not a risk factor with respect to implant outcomes. Probably, attention must be given to people who are not showing up anymore.

Conclusion

From this study population, it may be concluded that the clinical performance of mandibular 2-implant (with machined and titanium plasma spray surfaces) bar-supported overdentures, with a conventional loading protocol, was equally successful in younger and older patients during a 10-years' evaluation period as long as they are able to attend the clinic for care and aftercare. Age should not be considered as a sole factor to exclude patients from being treated with endosseous oral implants.

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